

a system observer comprising a state updater for predicting the underwater vehicle's position,  $\chi_n$ , based on a past estimate of the underwater vehicle's position,  $\chi_{n|n-1}$  and an estimate of the underwater vehicle's velocity over the sea bottom, and a maximum likelihood estimator, to estimate the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle's velocity over the sea bottom,  $\chi_n$  in a single point position match;

an extended Kalman filter that takes state updater's estimate of the underwater vehicle's position,  $\chi_n$ , and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n), and computes a linear Kalman filter position estimate at time (n),  $\chi_{n|n}$ ; and

a range corrector that utilizes the linear Kalman filter position estimate at time (n),  $\chi_{n|n}$ , a sea borne position marker, and a measured slant range from the at least one submersible vehicle to the sea borne position marker and computes a final estimate of the at least one submersible vehicle's position.

7. (AMENDED) The system of claim 2 wherein said means for predicting the at least one underwater vehicle's position, based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle's velocity over the sea bottom comprises a state velocity updater.

16. (AMENDED) A computer for the analytic determination of the position of at least one underwater vehicle acoustically coupled to a position marker having a known position using bathymetry data, positioning data, the underwater vehicle's velocity over the sea bottom, and a slant range from the position marker comprising:

a computer for computing

- (a) a prediction of the underwater vehicle's position,  $\chi_n$ , based on a past estimate of the underwater vehicle's position,  $\chi_{n|n-1}$  and an estimate of the underwater vehicle's velocity over the sea bottom with a state updater,
- (b) an estimate of the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle's velocity over the sea bottom,  $\chi_n$  in a single point position match with a maximum likelihood estimator,
- (c) a linear Kalman filter position estimate at time (n),  $\chi_{n|n}$  using the state updater's estimate of the underwater vehicle's position,  $\chi_n$ , and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n) with an extended Kalman filter, and